

**ENVIRONMENTAL ASSESSMENT
FOR THE
CONSTRUCTION AND OPERATION
OF THE
SOLAR ENERGY RESEARCH FACILITY
AT THE
NATIONAL RENEWABLE ENERGY LABORATORY
GOLDEN, COLORADO**

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1.0 INTRODUCTION

1.1 Purpose

The National Renewable Energy Laboratory (NREL, formerly the Solar Energy Research Institute or SERI) proposes to construct and operate a new Solar Energy Research Facility (SERF) on the south side of South Table Mountain near Golden, Colorado. The new facility would be comprised of three office/laboratory modules, slightly offset from one another to blend in with the natural topography. This Environmental Assessment (EA), DOE/EA-0620, evaluates impacts of the proposed action in accordance with the National Environmental Policy Act (NEPA) to determine whether a formal Environmental Impact Statement (EIS) is necessary or if a Finding of No Significant Impact (FONSI) is justified. Where previous EAs addressed site-wide development, this EA addresses specific impacts of the proposed Solar Energy Research Facility. The original EA, identified as DOE/EA-0101, Environmental Assessment, Solar Energy Research Institute, South Table Mountain, Jefferson County, Colorado, was written in 1980 to address site-wide impacts. An addendum to this document, the 1988 Addendum Updating Environmental Assessment of April 1980, was prepared to re-evaluate the impacts of continued development of the South Table Mountain (STM) site. A FONSI was found to be justified for both of these previous EAs.

1.2 Justification of Need

Since its inception NREL has conducted the bulk of its research activities in a leased building originally designed for office use and later converted to a laboratory. Given the nature of the building's original purpose and design, the building lacks many safety features normally found in a laboratory building. These features include a centralized ventilation system, full fire detection and suppression systems, chemical storage areas, and separation of administrative employee's work areas from laboratory hazards. Since the building contains no loading dock or freight elevator, chemicals and waste products must be transported through administrative personnel areas potentially exposing these persons to additional hazards. Additionally, installation/removal of large pieces of equipment requires costly demolition of interior and exterior walls and results in significant program delays. Finally, overall maintenance and operation of the building is controlled by Denver West Office Park which is not required to meet the Department of Energy's more rigorous environment, safety, and health standards.

The proposed SERF would be designed specifically for research and development activities and would meet or exceed all DOE environment, safety, health, and energy efficiency requirements. SERF would incorporate centralized ventilation, full building fire detection and suppression, a service

corridor separating research and administrative personnel from laboratory hazards, and a loading dock and freight elevators for chemical, waste product, and equipment handling. No underground storage tanks or wastewater treatment would be required for building operation. SERF would also be designed to take advantage of Denver's relatively mild, dry climate and abundant sunshine to reduce building energy consumption through extensive use of natural daylighting and evaporative cooling.

Upon completion of the SERF, 85% of NREL's existing photovoltaic research operations would be effectively consolidated on the STM site. This consolidation is anticipated to yield significant cost savings to the government in reduced utility charges, lower building operating and maintenance costs, reduction of costly lease payments, and should enhance research program efficiency while reducing DOE's environment, safety, and health risk.

The proposed SERF would house research and office facilities currently located in leased space in the Denver West Office Park and experimental activities temporarily housed in the Joyce Street Facility described in DOE/EA-0619. The SERF is needed to fulfill the following objectives:

- To allow the functional transfer of laboratories, associated offices, and support functions currently operating in Building 16 of the Denver West Office Park.
- To provide NREL a state-of-the-art, modular, flexible generic research laboratory facility that meets or exceeds all applicable ES&H standards/codes and which will meet the long-term needs of the Department of Energy/National Renewable Energy Laboratory programs.
- To provide laboratory and support space for conducting internationally recognized research in photovoltaics, solar heat technologies, and other solar research technologies.
- To be a center-of-excellence in photovoltaics and related material science technologies.
- To provide features such as easy access for large scientific equipment and isolation of equipment vibration which cannot be retrofitted into the existing leased space.
- To provide improved worker safety through such features as improved negative

pressure in laboratories, more effective fume hoods, and a separate sanitary sewer branch to serve laboratory facilities.

- To provide improved coordination with other NREL staff currently working in the Field Test Laboratory Building (FTLB) adjacent to the proposed SERF site. The current isolation of staff members at a number of different locations interferes with the interchange of ideas and the creativity resulting from interdisciplinary exchanges.
- To improve efficiency and coordination of support activities for the research activities currently conducted in Building 16 that would be relocated to the SERF. Maintenance staff, supply room, and shipping and receiving services are all located at the STM site.

1.3 Background/History

The Solar Energy Research, Development and Demonstration Act of 1974 (P.L. 94-473) authorized a federal program to develop solar energy as a viable source of the nation's future energy needs. As a means of implementing the act, SERI was created and began operations in leased facilities in the Denver West Office Park in July 1977.

In late 1981, the U.S. Department of Energy (DOE) acquired from the State of Colorado a 300-acre site that was part of Camp George West for the permanent SERI facility. The Field Test Laboratory Building (FTLB) was completed on this site in 1984. In September 1991, President Bush formally designated the institute as the National Renewable Energy Laboratory. The laboratory employs approximately 600 people; most are still housed in the leased facilities at the Denver West Office Park.

2.0 ALTERNATIVES

2.1 No Action

Alternatives to location and operation of NREL on the STM site were investigated in the 1980 EA (DOE/EA-0101). That review considered and eliminated the No Action alternative. Existing leased space in Building 16 of the Denver West Office Park is inadequate for all the reasons listed in the Justification of Need section. Additionally, one of NREL's congressionally mandated goals is to stimulate public interest in solar technology through demonstrations, tours, seminars and public meetings. It is not possible to meet this goal through continued use of the leased space, as described below:

- The interim facility has only marginally adequate safety and health features due to conversion of office space to laboratory space.
- It is marginally adequate from a technological perspective; providing, for example, little isolation for the vibration-sensitive instrumentation used in the research conducted by NREL.
- Space is inadequate, and researchers must work under crowded conditions.
- There is insufficient separation between laboratory and office space, resulting in increased risk to non-lab personnel.
- Air flow problems are known to exist with the existing ventilation systems.

2.2 Proposed Action

NREL proposes to construct and operate a new SERF on its 300-acre STM site, 8.5 miles west of downtown Denver. The objective is to provide permanent office and laboratory facilities for approximately 200 occupants to perform functions now conducted in leased space. One new building, consisting of three office/laboratory modules with approximately 115,000 square feet of floor space, an adjacent parking lot with 225 spaces located to the east of the existing FTLB, and a service road to access the existing waste storage facility are proposed (Figure 2.1).

This project would be a one-for-one replacement of an existing sub-standard leased facility located

2 miles to the east in the Denver West Office Park. Research projects to be relocated include those in photovoltaics, solar heat technologies, and solar energy. Additionally, the Amorphous Silicon Deposition experiments would be relocated to the SERF from the Joyce Street facility. These experiments have been non-operational for 10 months after a self-assessment determined continued operations in Building 16 presented an unacceptable risk due to the explosive nature of silane. Current plans are to move this research to a more suitable leased facility located 5 miles north-north-west of the STM site, until space can be made available in the proposed SERF. An external storage bunker would be incorporated into the proposed SERF design to accommodate storage of materials with explosive properties, such as silane.

The proposed SERF would be a two-floor concrete building constructed on a 60,000 square foot footprint designed to compliment the natural land features of the STM site. Construction of the SERF building would begin in the spring of 1992 with completion in the fall of 1993. The SERF project represents implementation of the second phase of planned STM site development as described in the 1987 SERI Site Development Plan (SDP).

In keeping with NREL's energy development objectives, the building would be energy efficient, would integrate passive solar features into its design, and would comply with energy standards set by DOE in 10 CFR Part 435. The energy design activities utilized the DOE-2.1D simulation model to arrive at the specific energy conservation features.

Office and laboratory personnel would conduct their activities in the new facility under operating procedures similar to those observed now in Building 16. Safe Operating Procedures (SOPs) are written in advance of every experiment which discuss safety precautions to be taken. In addition, all operations must comply with DOE and NREL safety requirements and those of the Occupational Safety and Health Act (OSHA), the Resource Conservation and Recovery Act (RCRA), the Colorado Department of Health regulations for fugitive dust control and air quality, the National Environmental Policy Act (NEPA), the Toxic Substances Control Act (TSCA), the Superfund Amendment and Reauthorization Act (SARA), the Clean Water Act (CWA), the DOE 5400 Order series, and all applicable regulations for the State of Colorado, Jefferson County, and the City of Golden. The SERF is intended to be permanent, and it is expected that the facility would remain in operation for the foreseeable future.

2.3 Other Alternative Actions

The following other alternative actions were considered:

- 1) Construction of the SERF at a location other than on the STM site.
- 2) Construction of the SERF at a different location on the STM site.
- 3) Leasing facilities at other offsite locations.
- 4) Subcontracting research and development work to outside consultants.

3.0 EXISTING ENVIRONMENT

The preferred location of the proposed SERF is on the STM site, located 8.5 miles west of downtown Denver and 4 miles east-south-east of the central business district of the City of Golden. Previously the STM site was part of the Colorado National Guard's Camp George West, and was used for sixty years as a troop training and staging area. The STM site is predominantly bordered by open grassland zoned for recreation and light-commercial activity. The small residential development of Pleasant View shares a common border with a portion of the STM site's southern boundary and the community of Applewood is located 1.5 miles to the east. Development of the STM site for NREL use is described in the 1987 Site Development Plan (SDP). Figures 3.1 and 3.2 show the location of the proposed SERF with respect to the surrounding environment.

3.1 Topography and Climate

The STM site primarily occupies the base of the south-facing slope of South Table Mountain (a mesa). Two primary drainage channels run through the site in a south to southeasterly direction from the mesa.

The Denver metropolitan area climate is classified as semi-arid, typified by sparse rainfall, low relative humidity, clear skies, and large diurnal and seasonal temperature variations. Tables 3.1 and 3.2 present current local temperature and precipitation data from the climate station located approximately 3 miles southeast of the STM site in the adjacent city of Lakewood.

3.2 Geology and Soils

Surface soils on the site are deep (90 inches thick), well-drained, calcareous and clayey material referred to as Denver Clay Loam. Development limitations include high shrink-swell potential, low strength, and low permeability. The vertical permeability and infiltration rates of surface soils are low enough that most of the precipitation runs off rather than infiltrates the soil.

The STM site is underlain by two aquifers, the Arapahoe (approximately 800 feet [250 m] below the elevation of the mesa top) and the Laramie-Fox Hills (about 1500 feet [450 m] below the mesa top).

3.3 Surface Water

Surface water on the STM site generally drains to the south, both on the mesa top and across the lower portions of the site. Most surface water from the site ultimately flows into Lena Gulch, a right-bank tributary of Clear Creek. Lena Gulch is located approximately one-half mile to the south of the STM site, running through the middle of operational Camp George West properties. The proposed SERF would be located between the two largest channels on the STM site, as shown in Figure 3.1. These channels average 10 feet in width and 4 feet in depth in the upper reaches, and are filled with grasses and shrub vegetation. As illustrated by the information provided in Table 3.3, these drainages can be considered intermittent at best, as running water occurs briefly in these drainages only during periods of snowmelt or storms. Drainage area and runoff information is presented in Figure 3.1 and Table 3.3.

3.4 Air Quality/Visibility/Odor

Motor vehicles and residential woodburning are commonly considered to be the primary local sources of air pollution, although the area includes a wide variety of industries. In 1986, Air Sciences, Inc. monitored noncriteria contaminants at two locations on the STM sites east and west of the FTLB. Of fifteen target compounds, only three were found in concentrations above detection limits. The concentrations were all well below odor thresholds and levels of concern [1].

Figure 3.3

WATERSHED AREAS

3.5 Flora/Fauna

Existing flora and fauna in the area of the proposed SERF on the STM site were studied in detail in the 1988 EA addendum [2] and are summarized below.

3.5.1 Flora

Vegetation on the STM site is approximately 60% grassland and 40% shrubland. The proposed SERF location contains primarily grassland. The small principal drainage on the west side of this location supports predominantly canyon shrub species. The eastern drainage supports some identifiable wetland vegetation.

The U. S. Fish and Wildlife Service (U.S. F&WS) indicated a concern for vegetation if any of the following species are present: Bell's twinpod (Physaria bellii), Weber monkey-flower (Mimulus gemmiparus), and Diluvium lady's tresses/Plateau lady's tresses (Spiranthes diluvialis). Field studies have determined that none of these are present on the STM site.

3.5.2 Fauna

U.S. F&WS expressed a concern if any of the following species are present: Black-footed ferret (Mustela nigripes), Peregrine falcon (Falco peregrinus), Bald eagle (Haliaeetus leucocephalus) and Eskimo curlew (Numenius borealis). Much of the agency's concern centers on species that might rely on prairie dog habitat and the effects of the loss of such habitat. Prairie dogs have not been identified on the site, thereby eliminating many of the potential wildlife concerns of the agency. No threatened or endangered species have been observed on the site, and none of the sensitive candidate species noted in the U.S. F&WS response letter to this EA effort has been identified at the proposed SERF location.

3.6 Historic/Archeological Resources

Camp George West was initially used as a National Guard rifle range in 1903 and was the permanent camp site for the Colorado National Guard from 1934 until after World War II. Some National Guard use of facilities at what is now the STM site continued until DOE took over ownership in the late 1970s [2]. Three structures of historic significance are shown in Figure 3.2.

Figure 3.4

HISTORIC FEATURES AT THE NREL SITE

The Colorado Historical Society (CHS) indicated in 1987 that the entire Camp George West site was found eligible for inclusion in the National Register of Historic Places (CHS Ref. 5JF145) due to the significance of Camp activities and the remaining presence of structures dating back to the 1930s. None of these structures would be impacted by the proposed construction of the SERF. A sitewide archeological survey performed in 1980 by Dr. Sarah Nelson (referenced in agency comments in Appendix) described only four isolated archeological finds. These finds were considered insignificant and did not suggest the presence of information which would indicate prehistoric use of the site.

3.7 Infrastructure

The STM site is located in a light commercial/industrial area in unincorporated Jefferson County. The Denver West Office Park, the current location of much of NREL's leased space, is less than 1 mile to the east of the STM site, where the proposed SERF would be constructed. The community of Pleasant View lies immediately to the south of the site.

3.7.1 Utilities

The Consolidated Mutual Water Company of Lakewood, Colorado, provides water to the existing operation in the Denver West Office Park and would also serve the SERF if built in the proposed location.

Pleasant View Water and Sanitation District in Golden, Colorado, provides wastewater service to the leased facility in Denver West Office Park and would serve the SERF if built in the proposed location.

Electricity and natural gas are supplied to the existing Building 16 operations and would be supplied to the proposed new SERF location by Public Service Company of Colorado.

3.7.2 Solid and Hazardous Waste Disposal

All activities performed by NREL conform to requirements of the Occupational Safety and Health Act (OSHA), the Resource Conservation and Recovery Act (RCRA) and U.S. DOE and NREL regulations and guidelines for the handling, use, and disposal of hazardous substances. DOE/NREL holds a RCRA Waste Generator's permit and is classified as a small quantity generator.

3.7.3 Transportation System

The NREL site is located two tenths of a mile north of Interstate 70, a major east-west highway. A

direct access interchange currently exists at Denver West Boulevard. A study conducted to evaluate traffic conditions and needed improvements was completed in June 1991 [3]. According to criteria set in the Manual of Uniform Traffic Control Devices, signals at the intersections studied are not justified at this time but may be installed at a later date. Bus service to the Denver West Office Park and the STM site is provided by the Regional Transportation District on four routes.

3.7.4 Public Safety Services

Law enforcement services for both the Denver West Office Park and the STM site where the proposed SERF would be located are provided by the Jefferson County Sheriff's Department.

The Denver West Office Park, where Building 16 is located, is within the Lakewood-Bancroft Fire Protection District. The STM site is not located within the boundary of any established fire district; however, a contract has been negotiated with the Lakewood-Bancroft Fire Authority (referred to as Lakewood Fire Protection District in agency contacts in the Appendix) to handle both emergency and routine calls. The nearest fire station is located 1.6 miles to the east of the proposed SERF location.

3.7.5 Zoning and Land Use

The STM site is an unzoned area of Jefferson County. Land along its eastern edge is beginning to be developed commercially as an expansion of the Denver West Office Park. A church-owned elementary school is the only development present east of the site.

South of Denver West Parkway, a vacant parcel of Camp George West is currently leased to the Colorado Division of Highways. The Colorado Law Enforcement Training Academy pursuit track lies on top of the mesa, approximately 1800 feet northwest of the proposed SERF location.

3.8 Socioeconomic

The six-county Denver metropolitan area had a 1990 census population of 1,848,319 people. The area has been experiencing steady growth from its 1980 population of 1,618,000 people. Jefferson County's 1990 population was 438,430.¹ Median household income in Jefferson County, from the 1990 census, was \$54,473. The area supports a generally stable population and housing, schools, and health services are adequate to meet local needs.

3.9 Wetlands

¹Jefferson County Planning office visit on Nov. 15, 1991.

Limited wetland areas totaling much less than one acre occur in the eastern drainage bottom (Figure 2.1). These are narrow, linear wetlands supporting spikerush, baltic rush, several types of sedges, bluegrass, hemlock, and field mint. A dense thicket of cottonwood, chokecherry, and American brooklime also occur in these wetland areas.

The intermittent nature of this drainage generally would not lend itself to formation of wetlands. When DOE acquired the land from the state of Colorado, this drainage was filled with concrete rubble for over 1000 feet of its length. Concrete was dumped in the drainage by the state of Colorado a few years prior to the land transfer. The wetlands were artificially formed due to blockage of the natural water flow. The rubble was removed in 1988, and since that time the extent of the wetlands has decreased significantly. It is expected that this trend will continue and eventually the wetlands will no longer exist.

The proposed SERF would be located approximately 1200 feet to the south-west of the wetlands as they currently exist in the drainageway. There would be no impacts to the wetland areas from either construction or operation of the SERF.

4.0 ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION AND ALTERNATIVES

4.1 Proposed Action

Potential impacts of NREL's development of the STM site were described in the 1980 EA and 1988 Addendum. The potential impacts included:

- Slope stability
- Expansive soils
- Increase in surface water runoff
- Increase in air pollution
- Loss of habitat
- Visual impact

The conceptual design for the proposed action, developed by Anderson DeBartolo Pan, Inc., responded to the concerns expressed in Section 4 of the 1980 EA (DOE/EA-0101) and the 1988 Addendum by minimizing environmental impacts. One new building composed of three office/laboratory modules that are offset to respond to the natural **topography** of the mesa (Figure 2.1) is proposed. The elevation of the proposed new structure would stay below the existing visual limits of development along the south side of South Table Mountain.

The design minimizes the cut and fill necessary, thus reducing the impact to site **geology and soils** and **slope stability**. The structure would be located away from steep slopes to reduce the threat from rockfall or landslides. Soils on site require special engineering design precautions to accommodate high shrink-swell potential, low strength and low permeability. These soils have moderate erosion and blowing potential due to their cohesive nature and the gentle slopes present.

No impact on **ground water resources** would be anticipated because disturbance of the land surface for construction and operation of the proposed SERF would be well isolated from all ground water in the area.

Proposed construction work would not disturb the existing primary **drainage channels** except for the placement of a precast concrete box culvert along the service road. Temporary disturbance would result from extension of utility service lines from the FTLB to the SERF. The Corps of Engineers has informed NREL that no dredge and fill permit under Section 404 of the Clean Water Act would

be needed for this proposed action.

Construction activity would disturb more than 5 acres of land. Therefore, the November 1990 **storm water discharge** regulations would apply, and a stormwater discharge permit would be required for SERF construction activities from the Colorado Department of Health under the National Pollutant Discharge Elimination System (NPDES) provisions of the Water Quality Act of 1987.

Dust and windblown soil from disturbed areas and heavy equipment activity constitute the most significant **air quality** and visibility concerns during construction. Diesel exhaust would be visible and may occasionally cause mild odors at nearby residences. Disturbed semi-arid soils are often slow to return to their original state of stability with respect to wind erosion potential.

Once construction and landscaping are complete, the primary sources of air pollution would include vehicular traffic, central plant boiler combustion emissions, and organic emissions from R&D laboratories. No incremental increase in **emissions from vehicular traffic** or **organic emissions from R&D laboratories** would be expected from the SERF since it would be a permanent replacement for the nearby leased facility.

The proposed SERF's boilers would be small boilers with an estimated heat input of 7 million Btu/h to 8 million Btu/h. **Combustion emissions** from the central plant's two natural gas-fired boilers would include carbon monoxide (CO), oxides of nitrogen (NO_x), non-methane hydrocarbons (NMHC), particulate, and probably sulfur oxides. NO_x are expected to be the primary emissions of regulatory concern. The concentration of NO_x in the stack is estimated to about 20 ppm, resulting in a maximum modeled instantaneous air concentration of 0.14 ppm, or 0.13 mg/m³. Since the NO_x regulatory significance level is in terms of an annual average (1.0 ug/m³), the instantaneous concentrations computed in the modeling study [4] are not readily comparable. Further, it should be noted from a regulatory standpoint that "significance levels" are applicable only in ambient air off-site. Thus, the instantaneous concentrations on-site used in this comparison would be quite conservative with respect to the corresponding annual average off-site. The primary concern for NMHC relates to its impact on photochemical reactions that lead to formation of secondary pollutants such as ozone; however, small boiler releases would result in an insignificant incremental contribution to area ozone levels. The boilers would be operated in compliance with necessary permit(s) and applicable state and federal air quality regulations.

Trace amounts of a variety of organic compounds would be released from **laboratory exhaust** stacks

by research activities. Experimental laboratory emissions are not required to be permitted according to state and federal air quality requirements. Wherever possible, the semiconductor and solar cell industries use liquid alternative sources for many materials previously used that were gaseous, because liquid compounds significantly reduce dispersion-related hazards. Since experimental facility stack emissions are highly variable, stack emissions tests would not produce a reliable profile of the overall emissions. Mass balance techniques along with cradle-to-grave recordkeeping more reliably estimate the fate of emissions. To estimate potential health and environmental impacts from the SERF, worst case short-term emission episodes have been modeled by Ventilation Engineering [4]. Site Integrity Dispersion Analysis (SIDA), an enhanced proprietary version of EPA's models INPUFF and ISC, was used to model the maximum potential instantaneous ambient air concentrations from accidental releases of several chemicals. The SIDA computer model utilizes Briggs spreading coefficients and incorporates the aerodynamic features of the site using a technique developed by Puttoch & Hunter. The maximum modeled instantaneous ambient air concentrations for all chemicals tested were significantly less than the Immediately Dangerous to Life and Health (IDLH) and Permissible Exposure Limits (PEL).

Short-term impacts to site **vegetation** would result from disturbance during construction. Long-term impacts would result from permanent loss of grassland areas due to placement of building improvements, parking lots and roadways. Increased erosion and dust would not be a long-term concern from permanent loss of grassland, as all disturbed areas would either be revegetated or covered due to placement of facilities.

Potential project-related impacts to **wildlife** include short-term vegetation and habitat disturbance due to construction and permanent habitat loss. **Habitats** in the adjacent drainages would not be impacted by construction or operation of the SERF; therefore, only those associated with permanently altered grassland areas would represent a long-term impact. No threatened, candidate, or endangered species have been recorded or observed during the **wildlife** study at the site. Impacts from the proposed action are not expected to be long term or significant to mammals or birds, including raptors.

No **archeological** resources of concern and only three **historic** features of significance have been identified on the STM site, as documented in the archeological survey report prepared by Dr. Sarah Nelson in 1980. The STM site contains three Camp George West structures which are eligible for nomination to the National Register of Historical Places by the State Historical Preservation Officer (SHPO); all of these features are well away from activities associated with construction and operation

of the SERF. The SHPO has acknowledged that the proposed SERF would have no impact on any of the features discussed in this paragraph [Appendix].

NREL staff have been working with the Consolidated Mutual Water Company to define **water supply** needs for the proposed SERF, and they have initiated design of required system improvements. These are expected to be minimal and would have no environmental impact.

The Pleasant View Water and Sanitation District has indicated that it can provide **wastewater services** to the SERF. The SERF would be designed with separate sanitary and laboratory wastewater collection systems. The two systems would join outside the building where each system can be sampled. From this point, one line would carry wastewater to the district sewer system. Current NREL administrative procedures call for local work station collection and control of concentrated acids, bases and other chemicals. These procedures prevent disposal through the laboratory sewer system. Discharge criteria set by the Pleasant View Water and Sanitation District would continue to be observed.

Hazardous waste disposal would continue to be regulated under a current EPA permit for the STM site. Waste types and volumes at the SERF would be essentially the same as those now generated at Building 16. In 1990, Building 16 laboratories generated 2340 Kg. of hazardous waste. The approximate composition of that waste was:

44%	Corrosive Waste
35%	Flammable Waste
7%	Oxidizer Waste
3%	Poison Waste
1%	Reactive Waste
10%	Non-Regulated Waste

NREL is committed to utilizing **energy conservation** practices that are consistent with NREL's energy research and development mission and DOE standards. The Energy Efficiency Architecture Sensitive to the Environment (E²ASE) energy design process would be employed by the project design team to ensure compliance with these objectives.

Traffic impact analysis concluded that the proposed construction and operation of the SERF would require no major street network improvements but would result in a need for improved signal controls. The I-70 north and south ramp intersections at Denver West Boulevard would become

congested during peak hours. The existing stop sign at Denver West Parkway/Denver West Drive would inhibit the flow of traffic to and from the proposed SERF location on Denver West Parkway. The Lakewood-Bancroft Fire Authority has requested a primary and secondary access to each facility at the site.

Law enforcement services would continue to be provided by the Jefferson County Sheriff's Department; the department has expressed no concern over the proposal. This service may be supplemented by government or private security firms.

Fire protection services would be provided through a contract with the Lakewood-Bancroft Fire Authority. The nearest station to the STM site is at 20th and Eldridge in Lakewood, with a response time of 1-1/2 minutes. This contract for fire protection is already in effect due to existing facilities at the STM site.

The use of the unzoned STM site for the SERF is consistent with **land planning** in Jefferson County, and other existing and projected industrial and commercial development on adjacent lands are compatible with NREL operations. A small residential area exists south of Denver West Parkway near the east end of the STM site; however, these homes have no access to Denver West Parkway and would not be adversely affected by the SERF construction and operation. A small, church-owned elementary school is located on an extension of Denver West Boulevard to the northwest of the intersection of Denver West Parkway; this school does not generate significant pedestrian traffic from small children, and it is located well away from the expected primary traffic flow along Denver West Parkway. Therefore, no adverse impacts from construction and operation of the SERF are anticipated.

The proposed action would provide a permanent facility to house functions now conducted in leased space in the Denver West Office Park, approximately 1 mile to the east and across I-70. Because a new permanent work force is not being brought into the area, long-term **socioeconomic** impacts would not occur. A 15-month increase in the demand for locally available construction workers is expected during construction; however, there would be no need to make provisions for housing a temporary work force. The steady growth of NREL's stable work population represents a positive long-term socioeconomic impact. NREL's projected growth due to programmatic changes would result in approximately 150 new jobs over the next 5 years. It is anticipated that 30 of these staff members would be housed within the SERF.

Project-specific notification was sent to agencies and individuals believed to be potentially affected by the proposed action. Eight agencies/individuals voiced some concern. The issues of concern focused on general traffic and drainage features (Jefferson County Planning and Public Works Departments and U.S. Soil Conservation Service [U.S. SCS]), xeriscape and wetlands preservation (U.S. SCS and U.S. EPA), attention to species of concern (Endangered Species Office, U.S. F&WS), caution about geologic hazards (Colorado Geological Survey), waste reduction and pollution prevention (Colorado Department of Health), and avoidance of a nursery (Colorado State Forest Service).

4.2 No Action Alternative

The No Action alternative would have a negative long-term impact on the effectiveness of NREL as the leading research laboratory in renewable energy technologies. Selection of this alternative would inhibit NREL's ability to respond to ever-changing mission needs effectively and efficiently and would discourage the further growth of NREL's operations. In addition, Building 16 cannot conform to current DOE energy conservation and best practice environmental control provisions as well as the proposed new facility could. Given the nature of Building 16's original purpose and design, it lacks many safety features normally found in a laboratory building. These features include a centralized ventilation system, full fire detection and suppression systems, chemical storage areas, and separation of administrative employee's work areas from laboratory hazards. Since the building contains no loading dock or freight elevator, chemicals and waste products must be transported through administrative personnel areas potentially exposing these persons to additional hazards. Additionally, installation/removal of large pieces of equipment requires costly demolition of interior and exterior walls and results in significant program delays. Finally, overall maintenance and operation of the building is controlled by Denver West Office Park which is not required to meet the DOE's more rigorous environment, safety, and health standards.

4.3 Construct SERF at a Location Other Than on the STM Site

Alternatives to the location and operation of NREL on the STM site were investigated in the 1980 EA (DOE/EA-1010). That review considered and eliminated alternative sites for construction of future NREL research facilities for programmatic reasons. Additionally, the STM site is currently owned by DOE and would not require additional land acquisition. NREL's previous experience in utilizing facilities located on other lands in the vicinity owned by DOE (i.e., Rocky Flats) has resulted in significant operational inefficiencies.

Constructing the SERF at a location other than on the STM site would have adverse socioeconomic

impacts greater than the proposed action. The isolation of staff members at a number of remote locations interferes with the interchange of ideas and the creativity resulting from interdisciplinary exchanges. Additionally, it would be difficult to achieve NREL's congressionally mandated goal to stimulate public interest in solar technology through demonstrations, tours, seminars and public meetings with research facilities not consolidated at one site.

4.4 Construct SERF at a Different Location on the STM Site

Since the 1980 EA, NREL's overall site development plan process has reviewed numerous alternative schemes for using the STM site, including placement of facilities. The current plan is substantially different from the plan considered in 1980 and represents a significant reduction in overall activity and associated environmental impacts.

Development of the current plan by Anderson Debartolo Pan has involved consideration of a wide variety of alternatives and has resulted in the current plan being adopted as the configuration that minimizes negative impacts while meeting operational requirements. The environmental implications of the plan were reviewed in the NREL Site Development Plan, 1991, prepared by Anderson Debartolo Pan and in the SERI Site Development Plan, 1987, prepared by Higgenbotham and Associates.

Location of the SERF anywhere else on the STM site would be expected to result in impacts equal to or greater than the proposed action. The proposed location avoids known historic sites, would not impact sensitive environmental features such as natural drainages, and would be located near the existing FTLB. This location on the STM site meets the objectives of the site development plan and the close proximity to the FTLB would result in less ground disturbance for extension of utility services. Locating the proposed SERF at the preferred location would affect no wetlands, critical habitats, floodplains, prime agricultural areas, special sources of water, or other designated sensitive areas. There are no unresolved conflicts concerning alternative uses of available resources as contemplated in NEPA Section 102(E) associated with the proposed project.

4.5 Leasing Facilities at Other Offsite Locations

This alternative has all the disadvantages of the current situation represented by the No Action alternative. In addition, if the chosen location were far from the existing and proposed facilities, increased socioeconomic impacts, as described in Section 4.3, would also be expected.

4.6 Subcontract Research and Development to Outside Consultants

Created by public law in 1974, the Department of Energy's (DOE) National Renewable Energy Laboratory is the nation's primary research laboratory responsible for the development of renewable energy technologies necessary to advance the national goals of improving the environment, maintaining economic competitiveness, and achieving energy security. In fulfillment of its mission, NREL conducts basic and applied research in photovoltaics, wind, biomass, solar thermal, and solar buildings energy technologies, as well as other areas of national environmental/energy technology interest. NREL experimental activity is characterized as primarily bench-scale basic and applied research and includes limited field testing.

Expertise in the areas of NREL responsibilities is not as prevalent and well developed as necessary to meet the nation's research and development needs for renewable energy. Subcontracting SERF activities would not effectively fulfill the nation's objectives for NREL.

NREL's designation as a national laboratory in September of 1991 reflects NREL's scientific accomplishments in research and development, integrity, quality of work produced, and achievements over the past 15 years.

Completion of the proposed SERF would result in a high percentage of NREL's existing research operations being effectively consolidated on the STM site. This consolidation would be anticipated to yield significant cost savings to the government in reduced utility charges, lower building operating and maintenance costs, elimination of costly lease payments, and should enhance research program efficiency while reducing DOE's environment, safety, and health risk.

5.0 ASSESSMENT OF THE RISK OF ACCIDENTS

5.1 Construction

Construction activities associated with the proposed action are common to most light industrial and commercial facilities. Construction workers would not be more prone to accidents on this project than on any other local construction-related activity. Primary access to the site is via a lightly developed, commercial road less than a mile from a major freeway interchange. Neither the site nor the access road is directly accessible from a residential area. Therefore, minimal risk to children and pedestrians is expected.

All construction activities would be performed in accordance with OSHA regulations. Although construction activities would not be expected to generate hazardous waste, any hazardous waste

issues which may arise unexpectedly would be handled in accordance with RCRA, Colorado Department of Health regulations, and all applicable federal, state, and local regulations including those specified by NREL and DOE.

5.2 Operation

Safety analyses have demonstrated that research activities carried out at the site would not present a high risk. Occupational risk for laboratory personnel is greater than the risk for administrative personnel due to the type of work and chemicals involved. As NREL is required to comply with OSHA and DOE occupational safety and health requirements, overall operational risks are minimal.

A Safety Analysis Review (SAR) was completed in October 1991 [5] for the photovoltaic research conducted in Building 16 of the Denver West Office Park. Photovoltaic research involves use of hazardous materials which must be strictly controlled to ensure worker safety. The SAR demonstrated that the risk associated with photovoltaic research was low. As this research would be transferred to the SERF upon completion of the building, the SAR represents a reasonable assessment of the risk for conducting photovoltaic research in the SERF. Due to the improved safety features discussed in Section 1.2 which would be incorporated in the SERF design, it could be assumed operational risks would be even lower than they are in the existing space for which the SAR was originally performed. As SERF activities are limited to research rather than production, only small quantities of chemicals would be used in the facility. The SAR concluded that a worst-case accident at Building 16 would not pose a risk of dangerous chemical exposure in off-site locations. Recent studies for the SERF [4], indicate that a similar incident at the proposed SERF could be expected to result in concentrations far below the levels shown in the SAR for Building 16. Natural disasters, such as earthquakes, floods, and tornadoes could cause failure of building systems but would activate fail-safe system controls.

5.3 Decommissioning

No specific plan for decommissioning exists because the facility is intended to be a permanent NREL facility.

6.0 PERSONS AND AGENCIES CONSULTED

Although previous inquiries to agencies during the course of earlier environmental assessment work have not indicated much concern about the environmental impacts associated with overall development of the STM site, project-specific notification was sent to agencies and others believed to be potentially affected by this proposed action. The general notification letter and a mailing list are included in the Appendix along with individual responses to the inquiries. Twenty-two inquiry letters were sent; those who did not respond promptly were subsequently contacted by phone. No final response letter was received from the Jefferson County Open Space program, but verbal discussions did not identify any specific concern.

7.0 MITIGATION OF IMPACTS

Section 4 of this report describes potential impacts that could be expected due to the proposed construction of the SERF at the STM site. Mitigation measures to address significant impacts identified in Section 4 are summarized below.

7.1 During Construction

The SERF has been designed to take advantage of the natural south-facing slope **topography** to minimize required site grading and maximize passive solar heating benefits.

Drainages that carry intermittent **surface water** flows would be preserved in their natural state to the greatest extent possible. Native and drought-resistant planting would be used in setbacks and would maintain natural pathways to the upper mesa.

Care would be taken to control **erosion** during construction, and permanent detention ponds would be constructed prior to other site improvements to catch runoff and prevent release of sediments downstream (Section 7.2). Erosion control blankets, mulch, and interceptor ditches would be provided, as necessary, to control erosion and allow revegetation to succeed. The slopes and bottoms of detention ponds would be seeded with native grasses for stabilization.

Construction may impact local **air quality** as soils are disturbed by heavy equipment and diesel engines emit exhaust. Mitigative dust control measures will be used during construction as defined in the Fugitive Dust Control Permit filed with the Colorado Department of Health. These actions would improve soil stability and minimize blowing dust.

The SERF would be located where **vegetative disturbance** would be confined to grasslands. Primary drainages, which contain canyon shrub and wetland vegetation, would not be disturbed except for the culvert crossing and extension of utility service lines through the drainage to the west of the SERF. Topsoil would be stockpiled for reuse on the finished grade areas, and native vegetation species would be introduced to allow rapid restoration of disturbed areas.

No **archeological** resources of concern have been identified at the site, but should any archeological resources be unearthed during construction, they would be reported to the SHPO immediately. Any activity that may damage any find would be stopped until clearance was received from the SHPO.

Noise from construction equipment is not anticipated to be a problem that would require special

precautions because the site is relatively isolated from residential areas. Also, direct access is provided from I-70 via a commercial/industrial access road that supports a very low level of existing development.

7.2 During Operation

The **SERF positioning** on the site would enhance energy performance by taking advantage of the sun exposure for early morning warm-up and by minimizing the west-southwest facade, which receives early shade. This angle also would improve the building's relationship to the drainageways, keep the building zone away from potential rockfall threats, and minimize adverse visual impact.

Surface water runoff from the proposed SERF would be collected in small detention basins south of the proposed parking lot. This detention system would be designed in accordance with Jefferson County standards to handle up to a 100-year-frequency storm and reduce the peak flows resulting from development of the new facility to predevelopment levels. A 12-foot- wide by 4-foot-high precast concrete culvert would be constructed to avoid inhibiting natural flow beneath the access road between the FTLB and the SERF.

Revegetation of the site following construction would remove the need for sediment control after construction and provide for long-term **erosion and dust control**. In addition, landscaping, maintained by a low-water usage irrigation system, is expected to reduce erosion potential well below that of the original surface.

Ventilation Engineering's air flow study [4] of the SERF in its preferred location sought to identify recirculation zones, recirculation cavities, and building edge vortices. The study was based on wind data collected at the NREL meteorological monitoring site in 1981 and 1982. The results of the air flow study were used to position SERF air intakes to prevent emissions from being pulled into the ventilation system. Emission outlets also have been designed to direct the emissions away from recirculation zones.

The air study computer model used to assess stack and air intake features calculated the potential maximum short-term impacts under a variety of meteorological conditions at a number of locations. Locations modeled included the air intakes on the SERF, SERF roof areas, ground areas around the SERF, and at the existing FTLB. Table 7.1 tabulates the highest calculated air concentrations from the dispersion modeling study for comparison with relevant levels of concern. The maximum modeled instantaneous ambient air concentrations for all chemicals are significantly less than the

Immediately Dangerous to Life and Health (IDLH), Permissible Exposure Limit (PEL) [6], and odor thresholds (7) even during worst-case accidental releases. Therefore, release of trace amounts of these emissions during routine operations would not result in significant ambient concentrations.

Table 7.1
Maximum Modeled Short-term Air Impact from Accidental Worst-case Release of
Chemicals Under Poor Meteorological Dispersion Conditions

Chemical	Stack Discharge Concentration (ppmv)	Maximum Modeled Instantaneous Air Concentration (ppmv)	IDLH Threshold (ppmv)	PEL (ppmv)	Odor (ppmv)
Arsine	13.99	0.03	6	0.05	0.5
Benzene	0.20	<0.0004	200	10	4.7
Germane	2.11	0	N/A	0.2	N/A
HCL	50.1	0.1	100	5	0.8
H ₂ Se	4.64	N/A	2	0.05	0.3
Phosphine	31.99	0.06	200	0.3	0.5
WF ₆	1.19	0.002	100	5	0.04

Note: All concentrations are listed in parts per million by volume (ppmv).

Modeled release rates are significantly greater than what would be expected during an actual accident since the hazardous gas cylinders at the SERF would be equipped with critical orifices to control release rates, and experiments using hazardous gases would utilize scrubbers or other forms of air treatment.

Traffic analyses concluded that the I-70 north and south ramp intersections at Denver West Boulevard require signals during peak hours. The existing stop sign at the Denver West Parkway/Denver West Drive intersection should be relocated to the Denver West approach to make Denver West Parkway the main street. This would decrease potential queuing, driver confusion, and accident potential.

In response to the Lakewood-Bancroft Fire Authority's request, both primary and secondary access to the SERF would be accomplished by providing separate main entrances from Denver West Parkway to the south sides of both the FTLB and the SERF; also a service road would be provided that allows secondary access to the north side of both the FTLB and the SERF.

7.3 Agency-specific Concerns and Mitigating Measures

The **Jefferson County Board of Commissioners and Public Works Division** believe that runoff from parking areas would be significant and mitigating measures should be considered.

- C The proposed SERF design utilizes detention ponds which would control surface water runoff from events as extreme as the 100-year frequency storm and would reduce the peak flows to predevelopment levels.

The **U.S. SCS and U.S. EPA** also expressed concerns over accelerated erosion in the natural drainage downstream of the project site and water quality impacts from parking lot runoff and construction activities. In addition, the **U.S. EPA** was concerned about impacts from pesticide, fungicide, and fertilizer application.

- C Grade-control structures have been incorporated into the design of the facilities and parking areas to minimize erosion and a detailed erosion control plan would be formulated by the contractor prior to the start of construction. Detention ponds would contain parking lot runoff and would allow settling of particulate and other substances which would lessen the impact on the downstream drainage. Minimal amounts of salt mixed with sand would be used for snow melt and ice control to minimize introduction of potentially harmful substances to the surface waters. Fertilizers and herbicides would be used in minimal amounts in landscaped areas only to control weeds.

Much agency attention is focused on preserving native fauna and flora. Comments from the **U.S. SCS, U.S. F&WS, U.S. EPA, and the State of Colorado, Division of Parks and Outdoor Recreation** included the following concerns:

1. Utilization of xeriscape landscaping
2. Preservation of riparian and wetland vegetation
3. Minimize disturbance of threatened or endangered species' habitats such as the black-footed ferret, bald eagle, peregrine falcon, and eskimo curlew
4. Minimize disturbance of threatened or endangered species candidates' habitats such

as the leopard frog, southwestern willow, long-billed curlew, plains topminnow, bell's twinpod, Weber monkey-flower, and Diluvium lady's tresses

- C The landscape architecture has extensively used native plant species and xeriscape principles in the conceptual design. Revegetation will be initiated immediately after construction to minimize the time that the soils are exposed.
- C The proposed action would minimally impact riparian vegetation in that a box culvert would be installed on the service road. Wetlands and wetland-type vegetation noted in drainages near the site would not be affected by the proposed construction activities.
- C None of the species of concern were identified during wildlife and vegetation surveys conducted at the proposed site.

The **Department of the Army, Corps of Engineers** indicated concern that although an Army permit would not be required, all other applicable federal, state, and local permits must be obtained.

- C NREL's Environmental Section has evaluated the permitting requirements and has addressed all applicable federal, state, and local permitting needs.

Engineering difficulties associated with slope stability, swelling soils, flood potential, and management of surface and groundwater are concerns of the **Colorado Geological Survey, Department of Natural Resources**.

- C The facility design minimizes cut and fill requirements, thus minimizing the impact to native soils. The SERF is located away from steep slopes which will lessen the potential for site/building damage due to rockfall or landslides. Engineering design precautions have been incorporated to accommodate the high shrink-swell potential and the low strength and permeability of the soils. Groundwater resources are physically isolated from surface activities such that the impact is negligible. Sediment loads to surface waters will be minimized by installation of detention ponds.

The **Colorado State Forest Service** is concerned that if a road is built out to Quaker Street,

a portion of their experimental nursery would be destroyed.

- C This is not a concern because the conceptual design for this project does not include a road such as that described above.

Potential for increases in traffic congestion and air pollution concern the **Jefferson County Public Works Division**.

- C Traffic studies have indicated that no major street network improvements would be needed because the SERF would not produce a net increase in traffic volume. Signal improvements would be necessary for the I-70 ramp intersections.

The **Colorado Department of Health** is interested in utilizing waste reduction and pollution prevention practices.

- C The proposed SERF would be designed to be energy efficient and would have comprehensive waste management procedures, as are now applied to Building 16 operations. Limited amounts of hazardous waste are accumulated annually and these amounts are not expected to increase in the proposed SERF.

8.0 REFERENCES

1. Colorado Air Quality Control Commission, Ambient Air Standards, "Classification of Non-Attainment Areas in Colorado," Adopted June 20, 1991, Effective July 30, 1991.
2. "1988 Addendum Updating Environmental Assessment of April 1980", Solar Energy Research Institute, South Table Mountain, Jefferson County, Colorado, September 1988.
3. "Traffic Impact Analysis--Expansion of the Solar Energy Research Institute, Jefferson County, Colorado," by Howard Needles Tammen & Bergendoff, Architects-Engineers-Planners, Denver, Colorado, June 1991.
4. "Air Flow Characteristics & Exhaust Stack Analysis, Solar Energy Research Facility," for Solar Energy Research Institute, Golden, Colorado, by Ventilation Engineering, Tempe, Arizona, August 23, 1991.
5. "Preliminary Safety Analysis Review, For the Use of Hazardous Materials in Photovoltaic Applications at the National Renewable Energy Laboratory," report by NREL, October 3, 1991.
6. "Air Contaminants--Permissible Exposure Limits," Title 29 Code of Federal Regulations Part 1910.1000, U.S. Department of Labor OSHA 3112, 1989.
7. "Warning Properties of Industrial Chemicals," Occupational Health Resource Center, Oregon Lung Association, Portland, Oregon, 1987.

9.0 ADDITIONAL REFERENCES

1. Council on Environmental Quality, "Regulations on Implementing National Environmental Policy Act Procedures," 40 CFR 1500-1508, FR 55990, November 29, 1978. Corrected by 44 FR 873, January 3, 1979; Amended by 51 FR 15625, April 25, 1986.
2. "Environmental Assessment," Solar Energy Research Institute, South Table Mountain, Jefferson County, Colorado, revised February 5, 1980.
3. "Conceptual Design Report Revision, Solar Energy Research Facility for Solar Energy Research Institute, Golden, Colorado," Vol. 1, by Anderson DeBartolo Pan, Inc., April 1991.
4. "Addendum to Traffic Impact Analysis of June 1991--Expansion of the Solar Energy Research Institute, Jefferson County, Colorado," letter by Howard Needles Tammen & Bergendoff, Architects-Engineers-Planners, Denver, Colorado, August 8, 1991.
5. Colorado Air Quality Control Commission, Ambient Air Standards, "Visibility Standards," Adopted December 21, 198
6. U.S. Environmental Protection Agency "National Pollutant Discharge Elimination System Permit Application Regulations for Storm Water Discharge; Final Rule," 40 CFR Parts 122, 123, and 124, November 16, 1990.

APPENDIX

OUTSIDE COMMENTS